IETF 112 Path Computation Element (PCE) WG

Wednesday, Nov 10, 2021 (14:30-15:30 UTC)
Friday, Nov 12, 2021 (16:00-17:00 UTC)

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Julien Meuric (julien.meuric@orange.com)
Dhruv Dhody (dd@dhruvdhody.com)
Secretary
Hariharan Ananthakrishnan (hari@netflix.com)

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- Individuals are prepared to contribute to the ongoing work of the group
- See BCP 54!

Agenda Bashing

Wednesday, November 10, 2021 14:30-15:30 UTC

Introduction

1.1. Administrivia, Agenda Bashing (Chairs, 5 min) [5/60]

1.2. WG Status (Chairs, 10 min) [15/60]

1.3. State of WG I-Ds and next steps (Chairs, 10 min) [25/60]

Segment Routing

2.1. Multipath ERO (Mike Koldychev, 10 mins) [35/60]

draft-ietf-pce-multipath-03

2.2. SR Policy (Mike Koldychev, 10 min) [45/60]

draft-ietf-pce-segment-routing-policy-cp-06

2.3. Path MTU (Luc-Fabrice Ndifor, 5 mins) [50/60]

draft-li-pce-pcep-pmtu-05

2.4. IFIT (Giuseppe Fioccola, 5 mins) [55/60]

draft-chen-pce-pcep-ifit-04

2.5. Ingress Protection (Huaimo Chen, 5 mins) [60/60]

draft-chen-pce-sr-ingress-protection-06

Friday, November 12, 2021 16:00-17:00 UTC

Update to PCEP

3.1. Relax Object Ordering (Dhruv Dhody, 10 mins) [10/60]

draft-dhody-pce-pcep-object-order-00

3.2. Topology Filter (Quan Xiong, 10 mins) [20/60]

draft-xpbs-pce-topology-filter-01

3.3. VTN in PCEP (Minxue Wang, 10 mins) [30/60]

draft-dong-pce-pcep-vtn-00

3.4. PCEP-LS (Gyan Mishra, 10 mins) [40/60]

draft-dhodylee-pce-pcep-ls-22

Multicast

4.1. BIER (Huanan Li, 10 mins) [50/60]

draft-li-pce-based-bier-02

Others

5.1. Color in PCEP (Balaji Rajagopalan, 5 mins) [55/60]

draft-rajagopalan-pce-pcep-color-00

5.2. VLAN-based Native IP (Yue Wang, 5 mins) [60/60]

draft-wang-pce-vlan-based-traffic-forwarding-01

Thanks!

Updated Rules for PCEP Object Ordering

draft-dhody-pce-pcep-object-order-00

Dhruv Dhody

PCE WG @ IETF 112

Some History

- The issue with RBNF and strict object ordering in PCEP keeps popping up!
- Errata - 6627
  - ordering between the LSP & CLASSTYPE objects in PCReq message
- Errata - 3672
  - Metric objects in the SVEC list
- See also draft-cmfg-pce-pcep-grammar-02
- And then John suggested this approach on the mailing list!

Motivation

- The mandatory object ordering requirement in [RFC5440] is shown to result in exponential complexity in terms of what each new PCEP extension needs to cope with in terms of reconciling all previously-published RFCs, and all concurrently work in progress internet drafts.
- This requirement does not lend itself for extensibility of PCEP.

Update to RFC 5440

- Section 6 of [RFC5440] states:
  - An implementation MUST form the PCEP messages using the object ordering specified in this document.
- This text is updated to read as follows:
  - An implementation SHOULD form the PCEP messages using the object ordering specified in this and subsequent documents when an ordering can be unambiguously determined; an implementation MUST be prepared to receive a PCEP message with objects in any order.
- This update does not aim to take away the object ordering completely.
  - It is expected that the PCEP speaker will follow the object order as specified unless there are valid reasons to ignore and the receiver is able to unambiguously understand the object meaning irrespective of the order.

Compatibility

- The messages generated by an implementation of this document when received by a legacy implementation with a strict interpretation of object ordering MAY lead to error handling.
  - It is interesting to note that the [RFC5440] does not define an Error-Type and Error-value corresponding to this error condition.
- Many implementations follow future proof techniques and are liberal in parsing the received PCEP messages.

Next Steps

- Is this the right approach to this problem?
- TODO - Scan all PCEP extensions to see if any other text needs to be updated related to object ordering.

Thanks!

Questions?

PCEP Extensions for Topology Filter

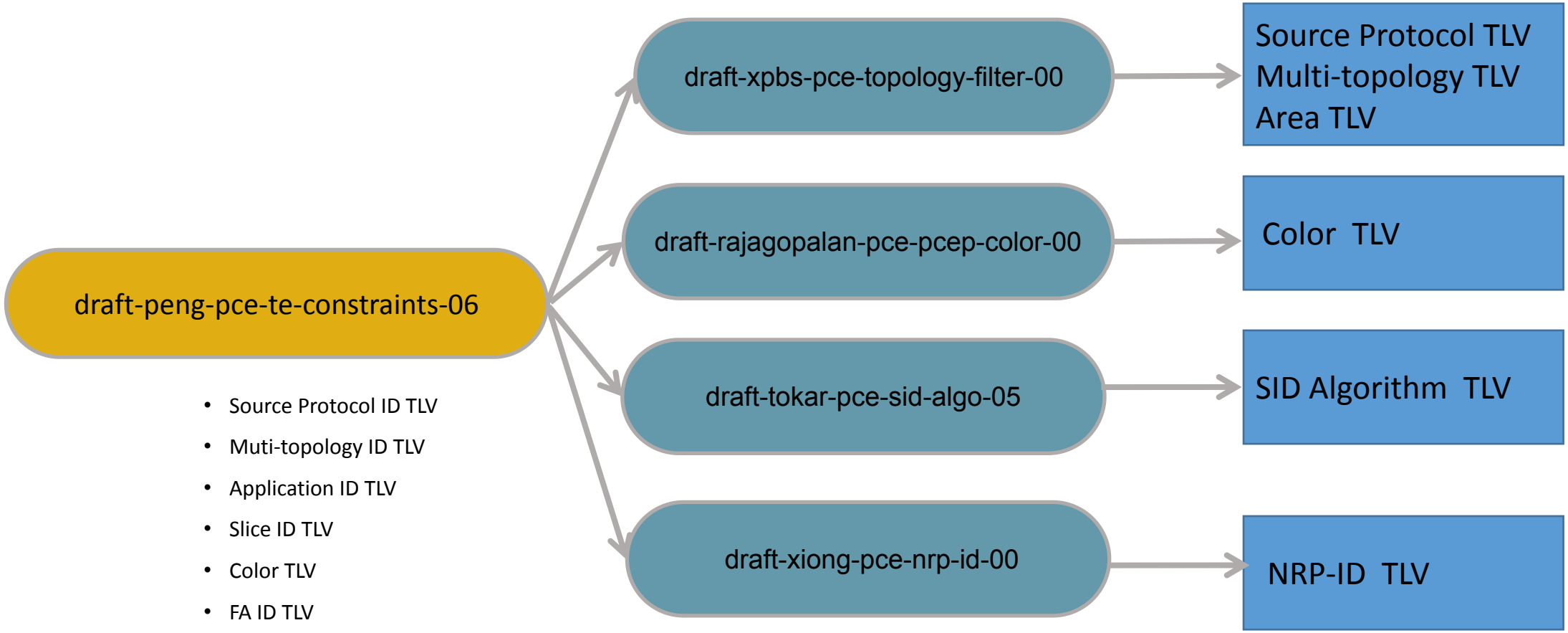
draft-xpbs-pce-topology-filter-00

Quan Xiong,Shaofu Peng(ZTE)
Vishnu Pavan Beeram,Tarek Saad(Juniper)
Mike Koldychev(Cisco)

IETF112 PCE, 2021, Online

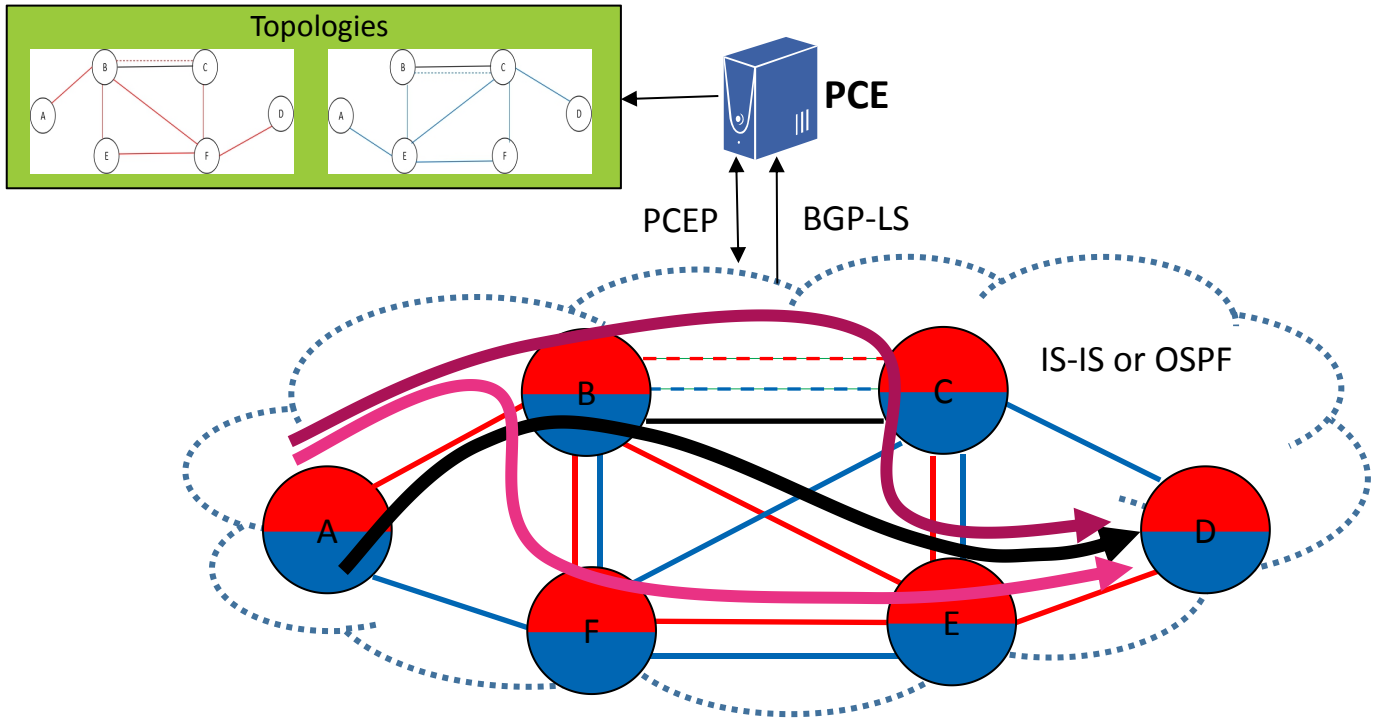
Recap

- draft-peng-pce-te-constraints-06 proposes a set of constraints for PCEP with the network information and has been replaced by servaral drafts as the following shown.



Overview of Topology Filter

- A topology filter is a data construct that can be applied on either a native topology or a user specified topology. and can be viewed as a set of filtering rules to construct the sub-topology.
- This document proposes a set of extensions for PCEP to support the topology filter as the topology constraints during path computation.



TOPOLOGY Object

- This document defines a new TOPOLOGY object to carry the topology filter. The following TLVs can be carried in TOPOLOGY object.
  - Source Protocol TLV
  - Muti-topology TLV
  - Area TLV
  - SID Algorithm TLV (draft-tokar-pce-sid-algo-05)

TOPOLOGY Object-Class is TBD1.

TOPOLOGY Object-Type is TBD2.

The format of the TOPOLOGY object body is:

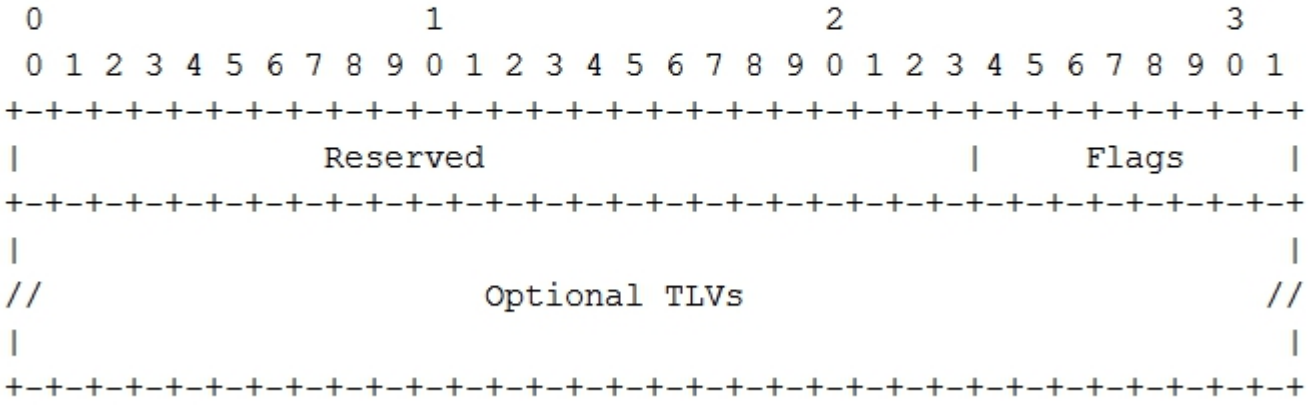


Figure 1: TOPOLOGY Body Object Format

TLVs for TOPOLOGY Object

- Source Protocol TLV
  - Sub-topology identified by the specific source protocol ID.
  - Protocol-ID and Identifier is defined as IS-IS [RFC8202], OSPF [RFC6549], BGP-LS [RFC7752].
- Multi-topology TLV
  - Sub-topology identified by the specific Multi-Topology ID within a source protocol.
  - Multi-Topology ID : as defined in IS-IS [RFC5120], OSPF [RFC4915], BGP-LS [RFC7752]
- Area TLV
  - Sub-topology identified by the specific Area ID.
  - Area-ID: Area identifier as defined in RFC7752.

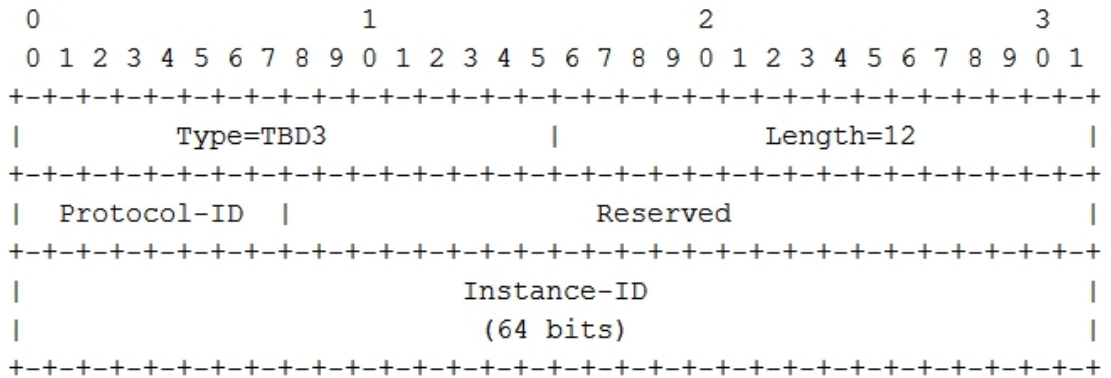


Figure 2: Source Protocol TLV

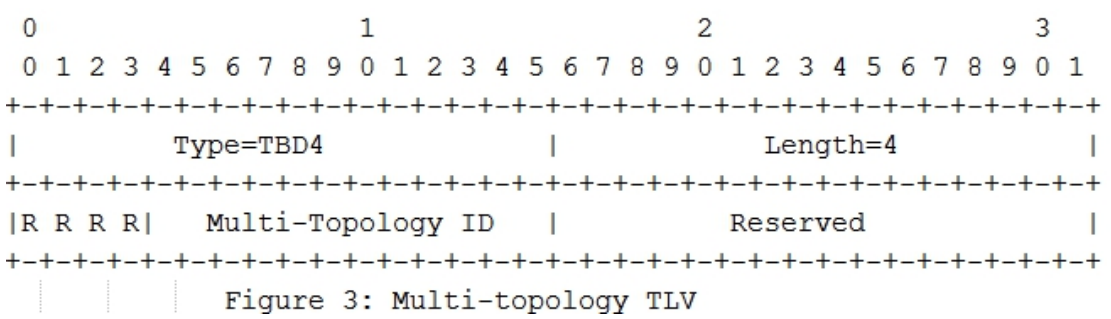


Figure 3: Multi-topology TLV

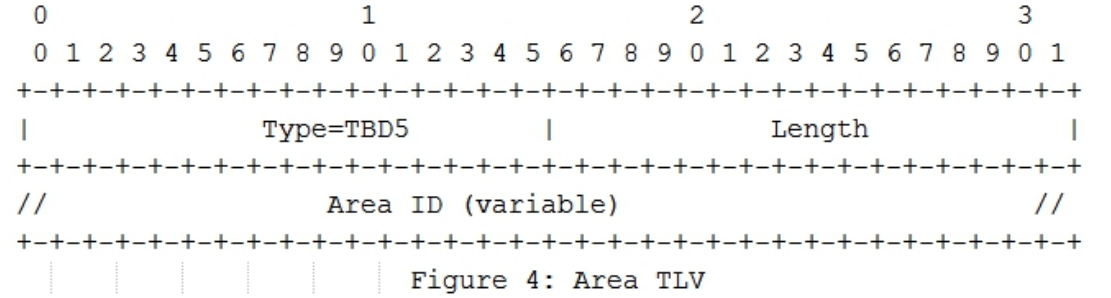


Figure 4: Area TLV

Include-any, include-all and exclude filtering rules

- The topology filters carries a list of filters. Each filter specifies a set of include-any, include-all and exclude filtering rules that can be applied on the native topology. This document proposes a set of extensions for IRO and XRO object.
  - Link ID subobject
    - defined in IS-IS RFC5307 and OSPF RFC3630.
  - Admin Group subobject
    - Extended Administrative Group as defined in [RFC7308].
  - Source Protocol subobject
    - Protocol-ID and Identifier is defined as IS-IS [RFC8202], OSPF [RFC6549], BGP-LS [RFC7752].

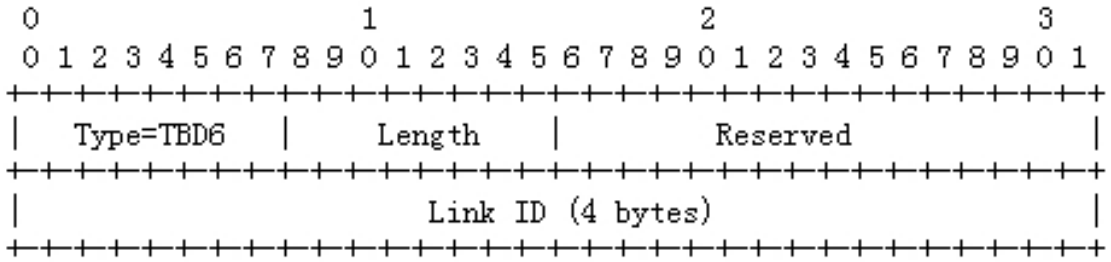


Figure 5: Link ID subobject in IRO

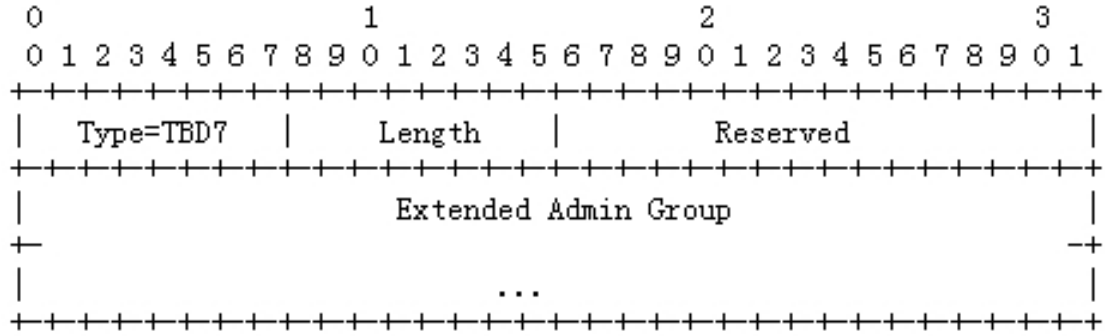


Figure 6: Admin Group subobject in IRO

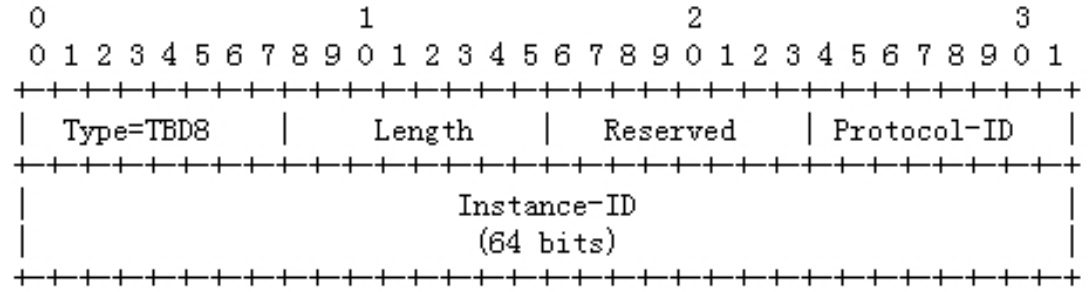


Figure 7: Source Protocol subobject in IRO

Next Step

- Comments and discussions are very welcome!

Thank you!

Support for VTN in PCEP

draft-dong-pce-pcep-vtn-00

Jie Dong, Sheng Fang @Huawei

Liuyan Han, Minxue Wang @China Mobile

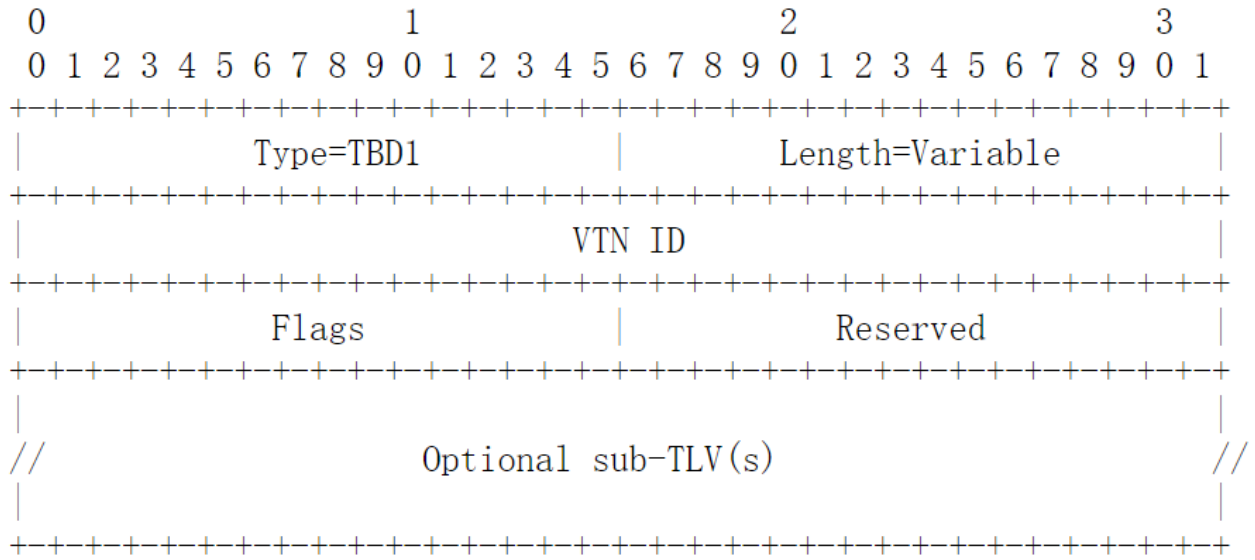
PCE WG IETF 112 Online Meeting Nov. 2021

Background

- A VTN is a virtual underlay network consisting of a set of dedicated or shared network resources, and is associated with a customized logical topology
  - Introduced in draft-ietf-teas-enhanced-vpn
  - Can be used to enable enhanced VPNs (VPN+) for the network slice realization
- When computing or establishing a path in a VTN, PCE needs to take the VTN-specific resource and topology attributes into consideration
- This documents describes the PCEP extensions to carry VTN information in PCEP messages for:
  - VTN-specific path computation request, response
  - VTN-specific path report and update
  - VTN-specific path initiation

PCEP Extensions

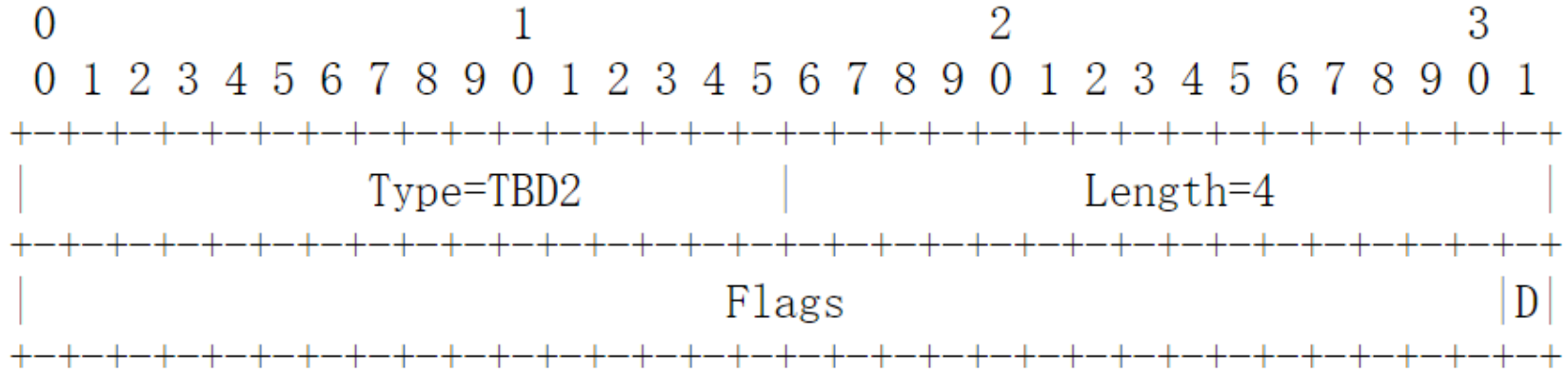
- A new TLV called “VTN TLV” is defined to carry the VTN ID and the related information in the LSPA Object



- VTN-ID: global significant 32-bit identifier
- Flags field: All the flags are reserved for future use
- Optional sub-TLVs: Can be used to carry additional VTN specific constraints

PCEP Extensions (Cont.)

- A new PCEP capability called “VTN-CAPABILITY” is introduced



- One bit called “D bit” is defined in the Flags field:
  - When set to 1 by PCC, it indicates that the PCC supports the encapsulation of data plane VTN-ID in data packet
  - When set to 1 by PCE, it indicates that the PCE supports to provide path computation result with the data plane VTN-ID

VTN-specific Path Computation

- VTN TLV can be used in basic PCE path computation
  - VTN TLV can be carried in a PCReq message to indicate the VTN in which the path computation is requested.
  - PCE SHOULD use the network resource and topology attributes associated with the specified VTN as the parameters of path computation.
  - VTN TLV may be carried in the PCRep message to indicate the PCC should use the VTN-specific resources the data plane VTN-ID in constructing the TE path.
  - In case of path computation failure, the PCRep message may carry the VTN TLV to indicate the computation in the VTN was not successful.

VTN-specific Path Report and Update

- VTN TLV can be used for Path report and update of Stateful PCE
  - PCC MAY include the VTN TLV in PCRpt message to indicate the VTN in which the TE path is reported.
  - PCE MAY include the VTN TLV in PCUpd Message to indicate the VTN in which the TE path needs to be updated.

VTN-specific Path Initiation

- VTN TLV can be used in PCE-Initiated LSP Setup
  - PCE MAY include the VTN TLV in PCInitiate message to indicate the VTN in which the path is to be created or deleted
  - PCC will use the VTN-specific resources and data plane VTN-ID (if D bit is negotiated) in constructing the TE path.
  - The mechanism is applicable to the initiation of MPLS LSPs and SR Policy candidate paths

Next Steps

- Comments and feedbacks are welcome
- Polish the draft based on feedbacks

Thank You

PCEP-LS: PCEP extensions for Distribution of Link-State and TE Information

draft-dhodylee-pce-pcep-ls-22

Gyan Mishra, Verizon

PCEP-LS Feedback recap...

- Was presented at IETF 110.
  - Highlighted some key scenarios such as PCECC & H-PCE
- Note: This is an experimental I-D with an aim to progress R&D efforts & is not a replacement for any existing mechanisms
  - There are specific scenarios highlighted where the reuse of PCEP sessions for this information is deemed useful
- What would be useful is to help progress this draft is find out if there is interest in this experimental work and a poll for WG adoption can be issued.

PCEP-LS Feedback recap...

- Positive feedback on the list
  - Aijun Wang with China Telecom showed key interest
    - Highlighted the use of PCEP-LS in PCECC scenarios
  - Peter Park with Telco KT
  - Bin Yun with ETRI
- Plea for WG adoption on Experimental track
  - Scope & goal of the experiment would include testing this solutions viability to help eliminate any concerns
- Post Adoption
  - Refine the scope of the Experiments & expected output, especially targeting scalability concerns and impact in other protocols and the network.

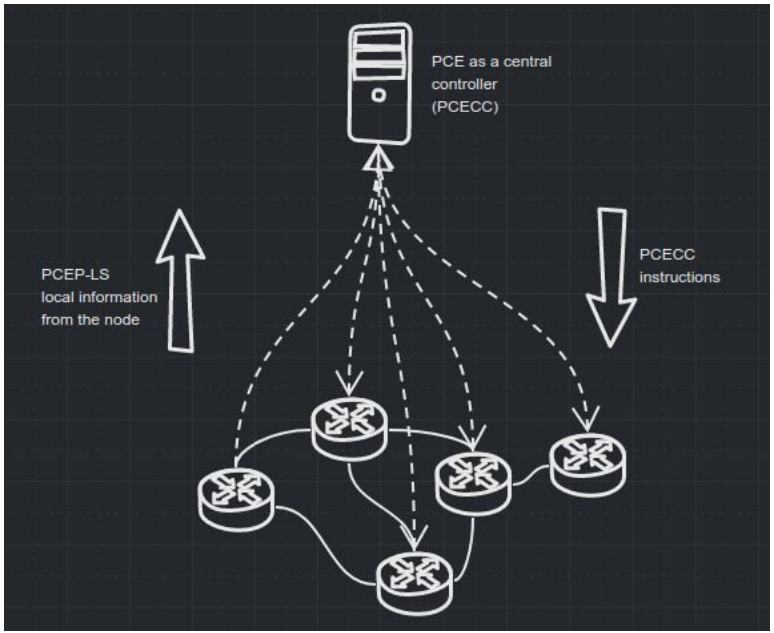
Quick Overall Recap…

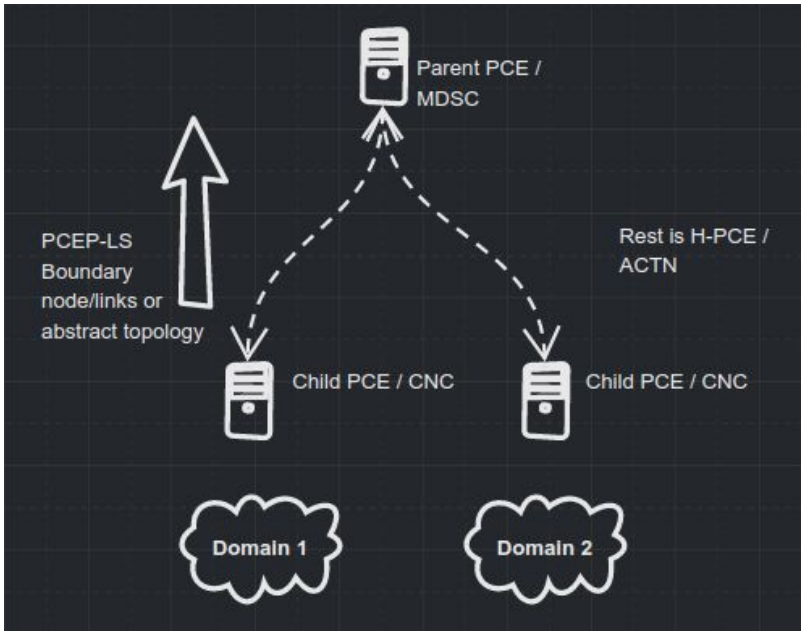
- Update on latest Feedback from PCE Working Group ⇔ WG Adoption Poll?
- Use of PCEP to also learn the network topology and state
- Applicable to Device to controller as well as controller to controller (H-PCE)
- Complementary extension (or another tool in the tool-box)
  - Not a replacement for running IGP in your network!
  - Or BGP-LS, Or Netconf!
  - Enable use of a single control plane protocol as an SBI in some scenarios
- A new PCEP Message and Object and reuse the TLVs already defined
  - Default is local-only (remote learned information can be enabled

Some Use Cases & Scenarios where PCEP-LS is an attractive choice!

- PCECC
  - Some use cases require direct PCEP session to all nodes
  - Reusing the same session to also learn local network state is attractive
  - Enable the possibility of a single SBI protocol for some use cases
- H-PCE (and ACTN)
  - Between controllers for boundary nodes/links as part of the abstract domain topology
- Partial
  - Some information such as Optical extension learned via PCEP-LS for faster learning
  - Reusing PCEP synchronization optimization techniques and incremental updates
  - Other mechanism can co-exist

Flow of information/control





Ready for WG Adoption?

- Is there enough interest by some in the WG to work on this? Yes*
- Are there targeted experiments, demo, implementations? Yes*
  - Some were showcased in the past in Hackathon and Bits-n-Bytes
  - Some open source implementation exist and documented
  - Some researchers have shown interest and experimented
  - Some operators have shown interest
- Is there a possibility of a somewhat rough consensus/support for this as an Experimental I-D? Yes*
  - Scope of the experiment can be further refined after adoption

Useful References

- Chairs Slide from IETF 101: https://datatracker.ietf.org/meeting/101/materials/slides-101-pce-update-on-pcep-sdn-discussion-00.pdf
- Mailing List Thread: https://mailarchive.ietf.org/arch/msg/pce/TXS2v8tXWCxXmp8Vxx59K2dOwCg/
- Implementation: https://mailarchive.ietf.org/arch/msg/pce/0zEEJv-u7mQ1drkkWkAJXLQnDpo/ and https://mailarchive.ietf.org/arch/msg/pce/HF_X3oUS7rIrjyymaw7miUQurpI/
- Researcher: https://mailarchive.ietf.org/arch/msg/pce/p1vKMyCWVxAd-Dpb5lcKX42BcVA/

Working Group Adoption ??

Thank You!

A rough summary of where we left off...

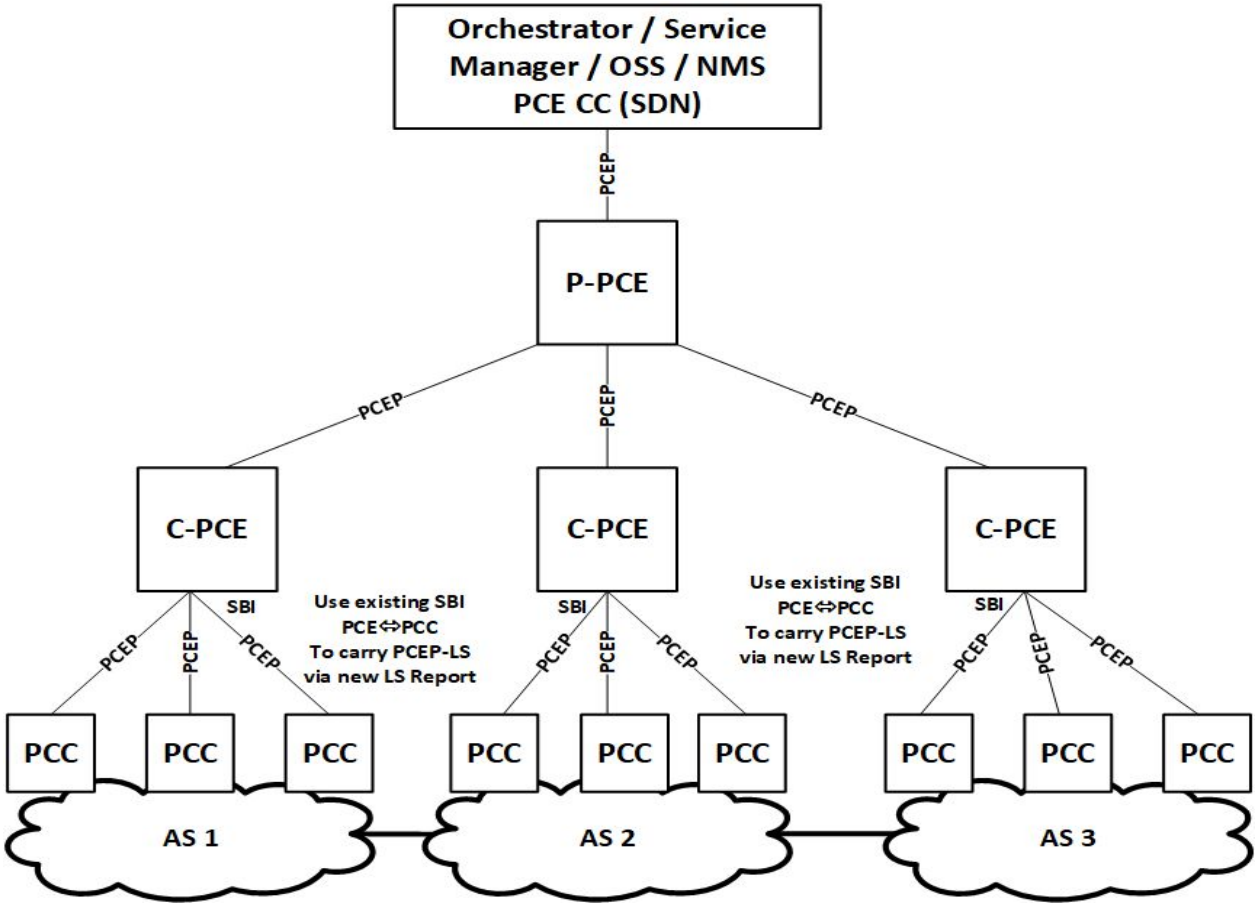
- Presence of other ways to do this
  - and some consider them to be better!
- PCEP scalability worries!
- Operational Complexity!
- Does this require multi-vendor inter-operable RFC?

Some of these questions would be tested & answered as part of the Experiment!

- Consensus on use of PCEP as SBI
- In some PCECC scenarios, there is a direct PCEP session with the nodes
  - Leveraging the direct PCEP session to also learn topology (and changes) is an attractive option!
- Usefulness in H-PCE, Inter-layer, Optical etc
- Another tool in the tool-box (and not replacing any other mechanism)
  - For instance we recognize that some may want to use YANG Path computation RPC instead of PCEP in some scenarios and we support both approaches!

Backup

- Scalability Concern
  - Some PCECC scenarios already have session to all nodes
  - Reusing the same session to also carry local node information is okay
  - Bulk of the work during PCEP session establishment and before any other PCEP interactions!
- Some benefits of PCEP-LS procedures
  - Incremental changes only
    - Use of stateful techniques: LS-ID to uniquely identify node/link and only the attributes that have changed need to be encoded
  - Synchronization Optimization techniques for PCEP
    - Can be leveraged for PCEP-LS as well during session up/down


Orchestrator / Service
Manager / OSS / NMS
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PCEP
P-PCE
PCEP
PCEP
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C-PCE
C-PCE
C-PCE
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SBI
SBI
Use existing SBI
PCE⇔PCC
To carry PCEP-LS
via new LS Report
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AS 1
AS 2
AS 3

PCE based BIER Procedures and Protocol Extensions

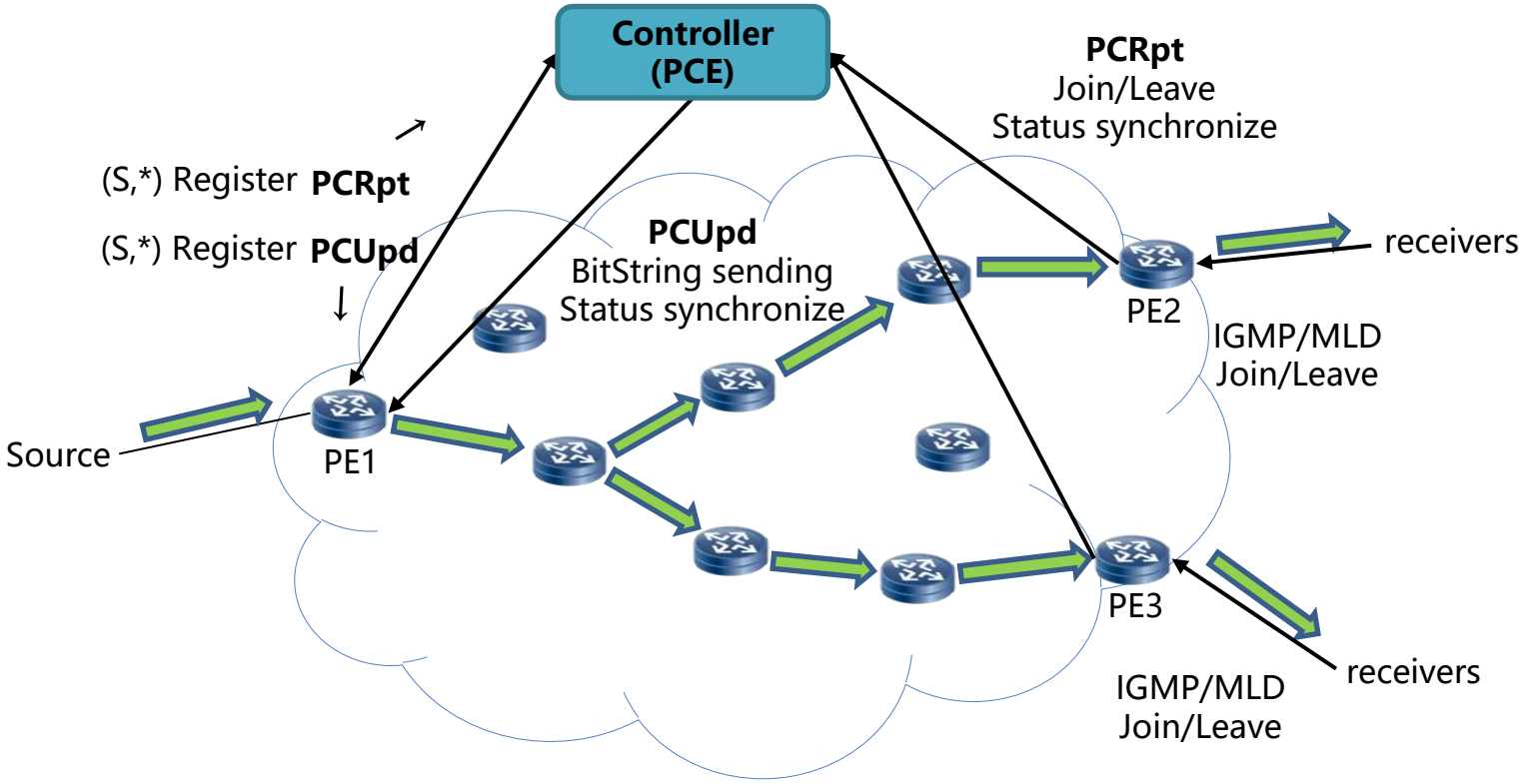
[draft-li-pce-based-bier]

Huanan Li(China Telecom)
Aijun Wang (China Telecom)
Huaimo Chen(Futurewei)
Ran Chen(ZTE Corporation)

IETF 112, November. 2021

- Overview of PCE based BIER solution
- Updates
- Further Action

Overview of PCE based BIER solution



Main flow for PCE based BIER multicast

1. PCE receives the registration information from ingress and responds.
2. PCE gets reports about egresses in PCRpt.
3. PCE generates BitString and sends it to ingress via PCUpd.
4. Ingress encapsulate BIER header and forward multicast packets.
5. The number of receivers is regularly synchronized between egress and PCE, and between PCE and ingress, using PCRpt and PCUpd respectively.

New TLVs

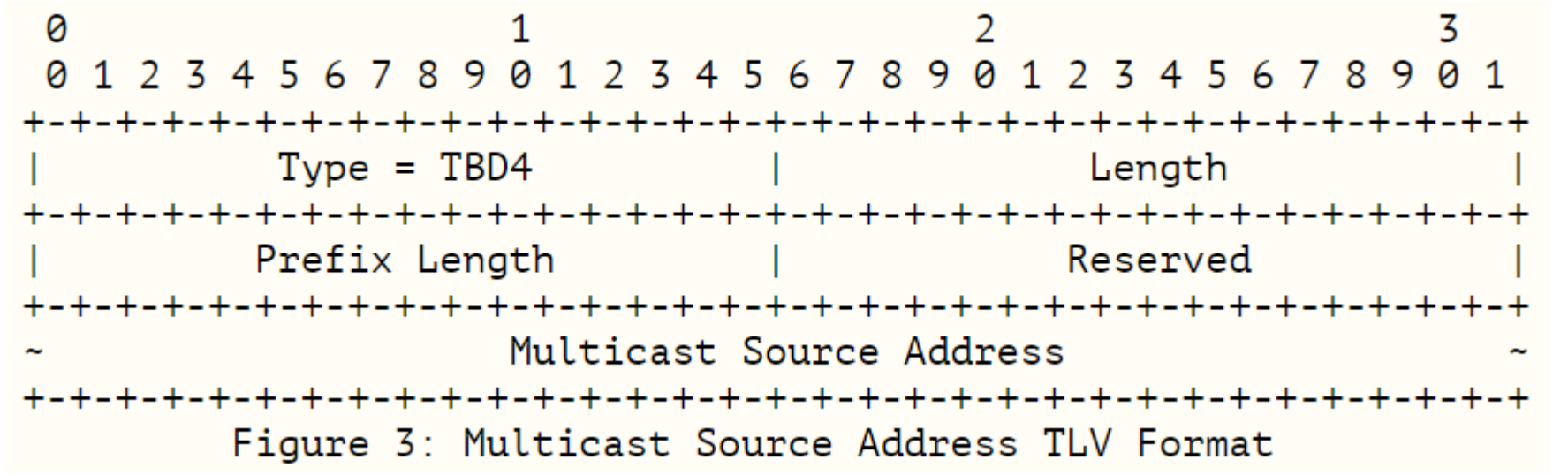


Figure 3: Multicast Source Address TLV Format

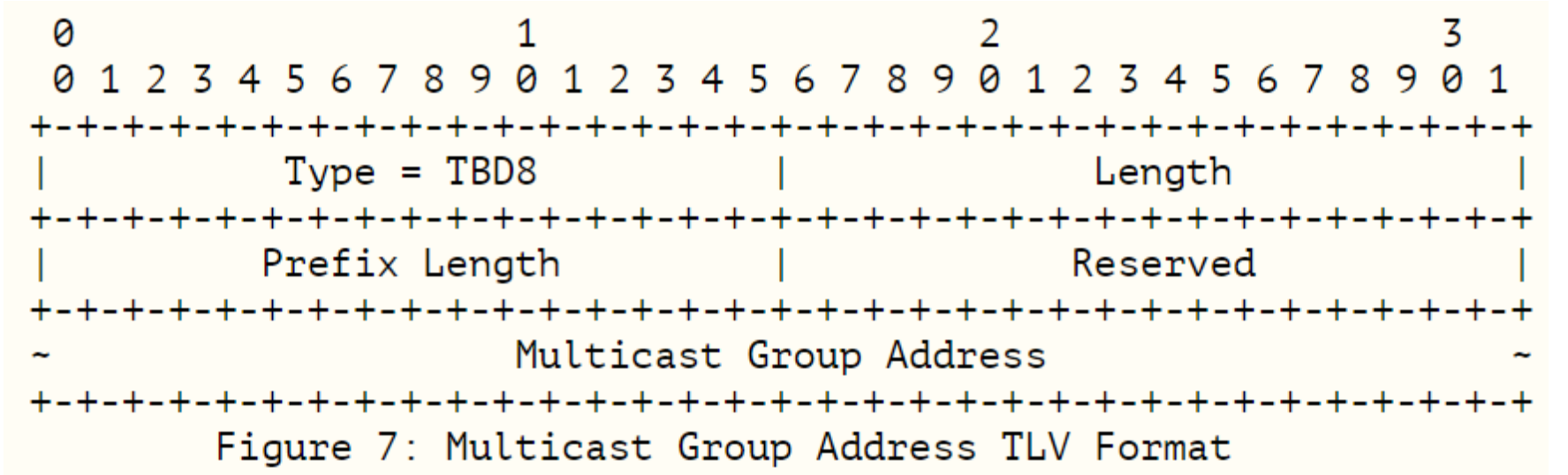


Figure 7: Multicast Group Address TLV Format

New TLVs

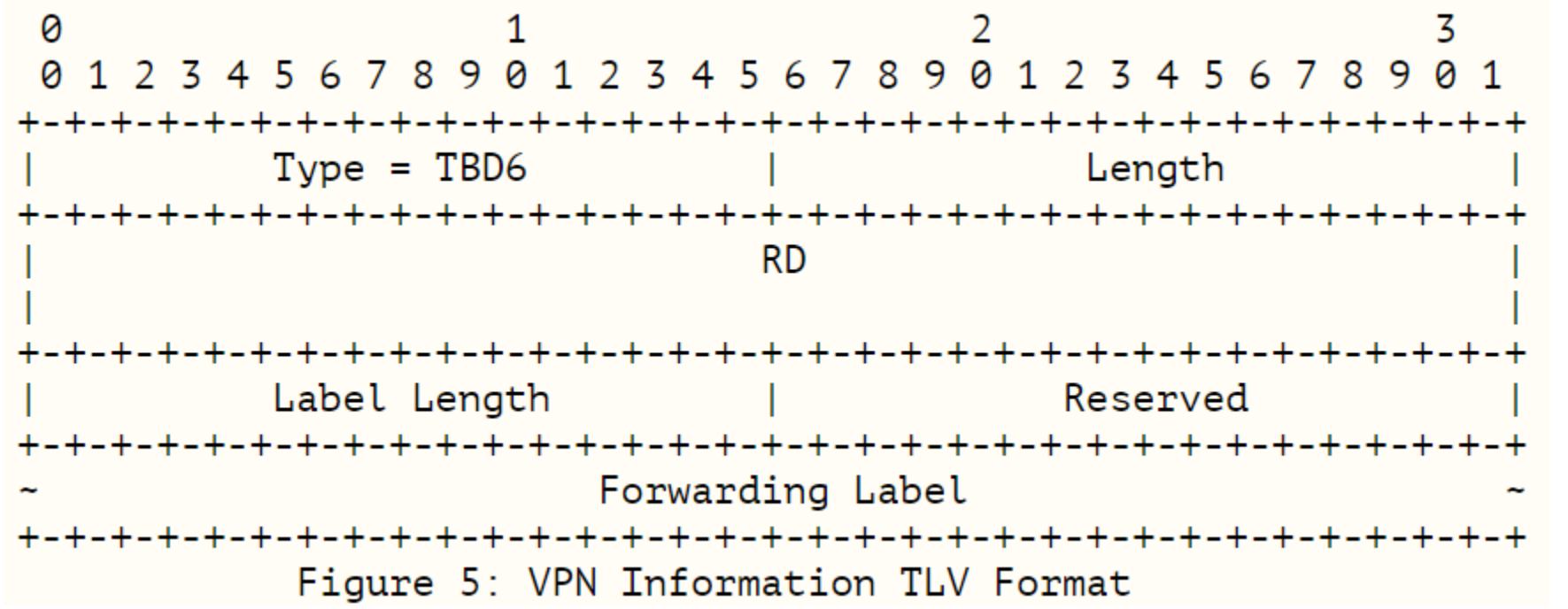


Figure 5: VPN Information TLV Format

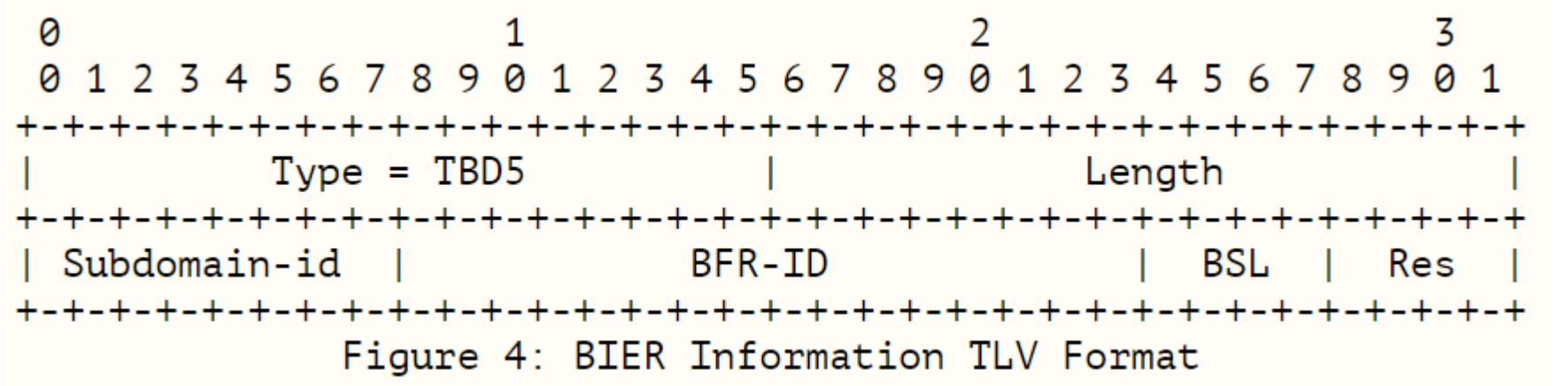


Figure 4: BIER Information TLV Format

Update for Multicast Source Registration Object

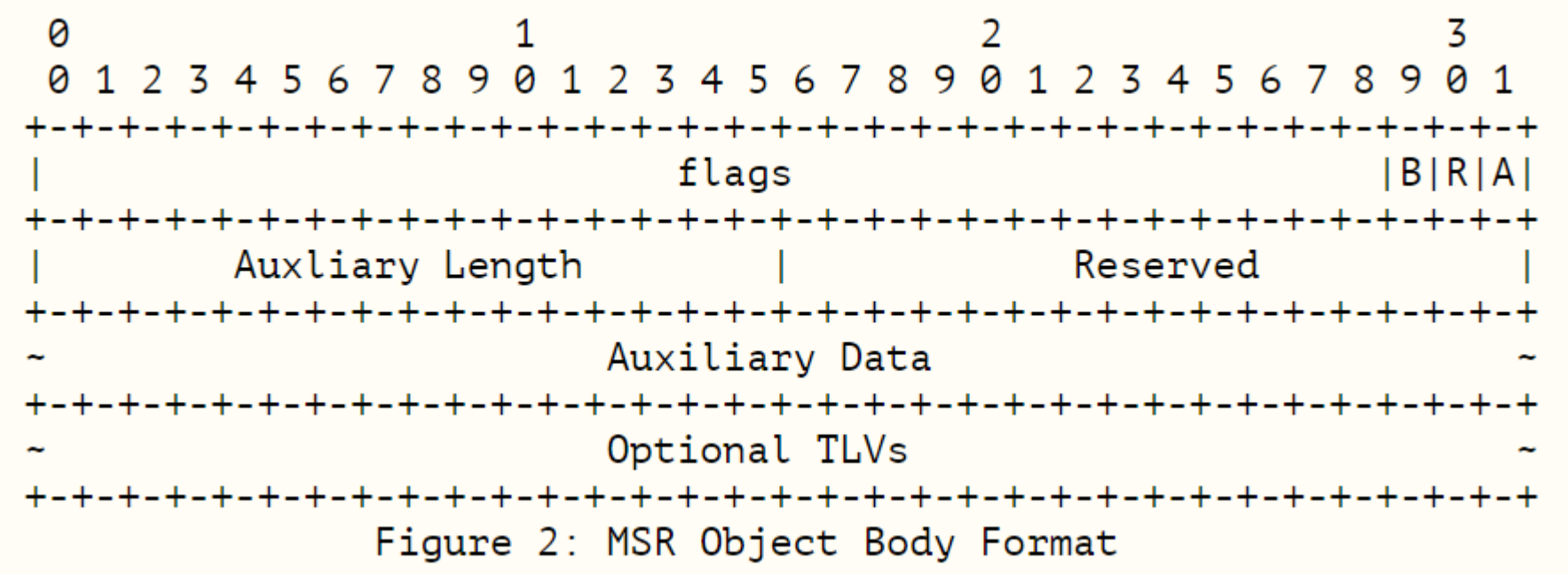


Figure 2: MSR Object Body Format

- ✓ Can be used in both BIER and non-BIER scenarios

- ✓ BIER:

Multicast Source Address TLV, VPN Information TLV, BIER Information TLV

- ✓ Non-BIER:

Multicast Source Address TLV, VPN Information TLV

Update for Multicast Receiver Information Object

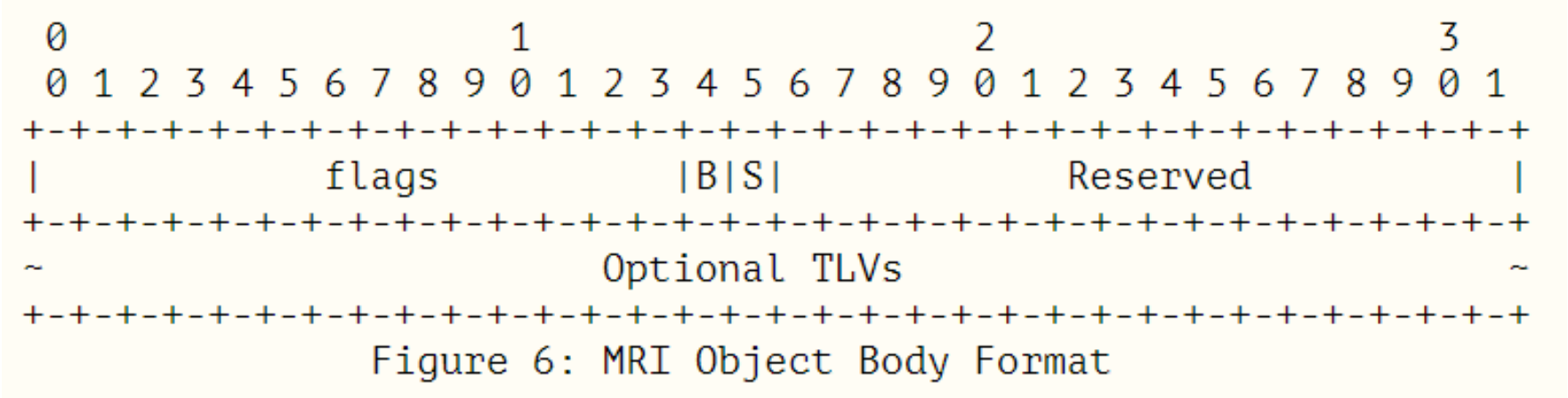


Figure 6: MRI Object Body Format

- ✓ Can be used in both BIER and non-BIER scenarios

- ✓ BIER:

Multicast Source Address TLV, Multicast Group Address TLV, VPN Information TLV, BIER Information TLV

- ✓ Non-BIER:

Multicast Source Address TLV, Multicast Group Address TLV, VPN Information TLV

Update for Forwarding Indication Object

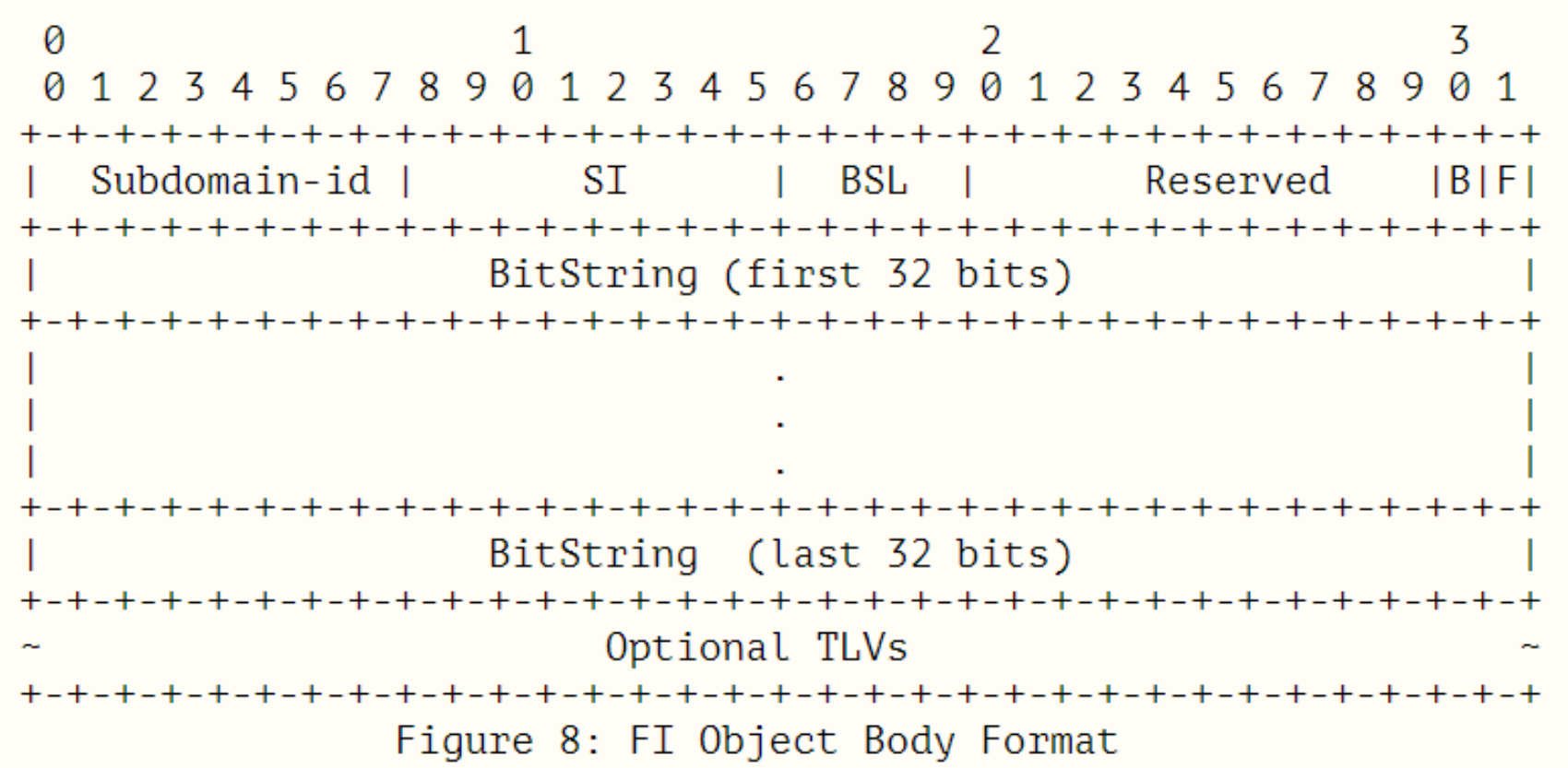


Figure 8: FI Object Body Format

✓ Can be used in BIER scenario:

Multicast Source Address TLV, Multicast Group Address TLV, VPN Information TLV

Update for Multicast Receiver Status Object

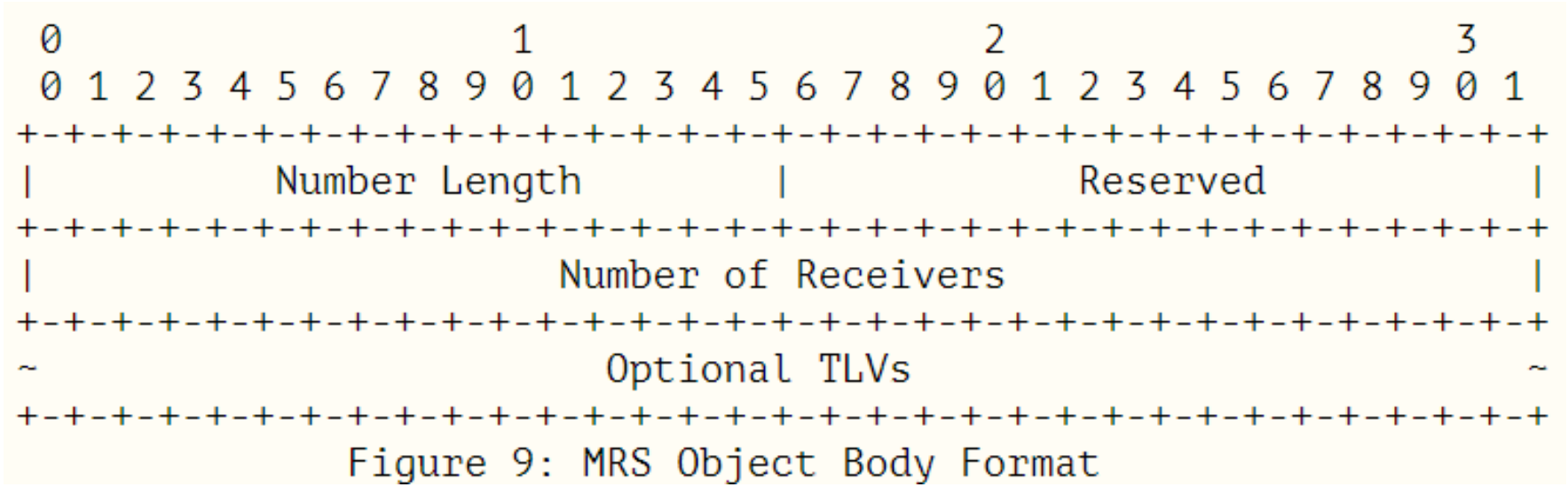


Figure 9: MRS Object Body Format

- ✓ Can be used in both BIER and non-BIER scenarios
- ✓ BIER:

Multicast Source Address TLV, Multicast Group Address TLV

- ✓ Non-BIER:

Multicast Source Address TLV, Multicast Group Address TLV

Next Step

- Comments

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PCEP Color

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OVERVIEW

- First version of the draft replacing:
  - https://datatracker.ietf.org/doc/draft-rajagopalan-pcep-rsvp-color/
- Technical overview was presented at IETF 111:
  - https://datatracker.ietf.org/meeting/111/materials/slides-111-pce-sessa-31-rsvp-color-00
- Based on comments & feedback, spun up a new draft

CHANGES

- Color is now more general
  - No longer restricted to RSVP's usage, although how RSVP uses it remains unchanged since the last draft
- Example additional uses are as follows:
  - Used for selecting candidates of composite paths:
    - https://www.ietf.org/archive/id/draft-ietf-pce-multipath-03.txt, Section 4.6
  - Looser definition permits application of local policies based on color (e.g., select path constraints/optimization profiles by color)
- More authors have joined to collaborate on the draft

NEXT STEPS

- Solicit WG adoption
- Request further feedback

THANK YOU!

PCEP Procedures and Extension for VLAN-based Traffic Forwarding

[draft-wang-pce-vlan-based-traffic-forwarding]

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IETF 112, Nov. 2021

Motivation

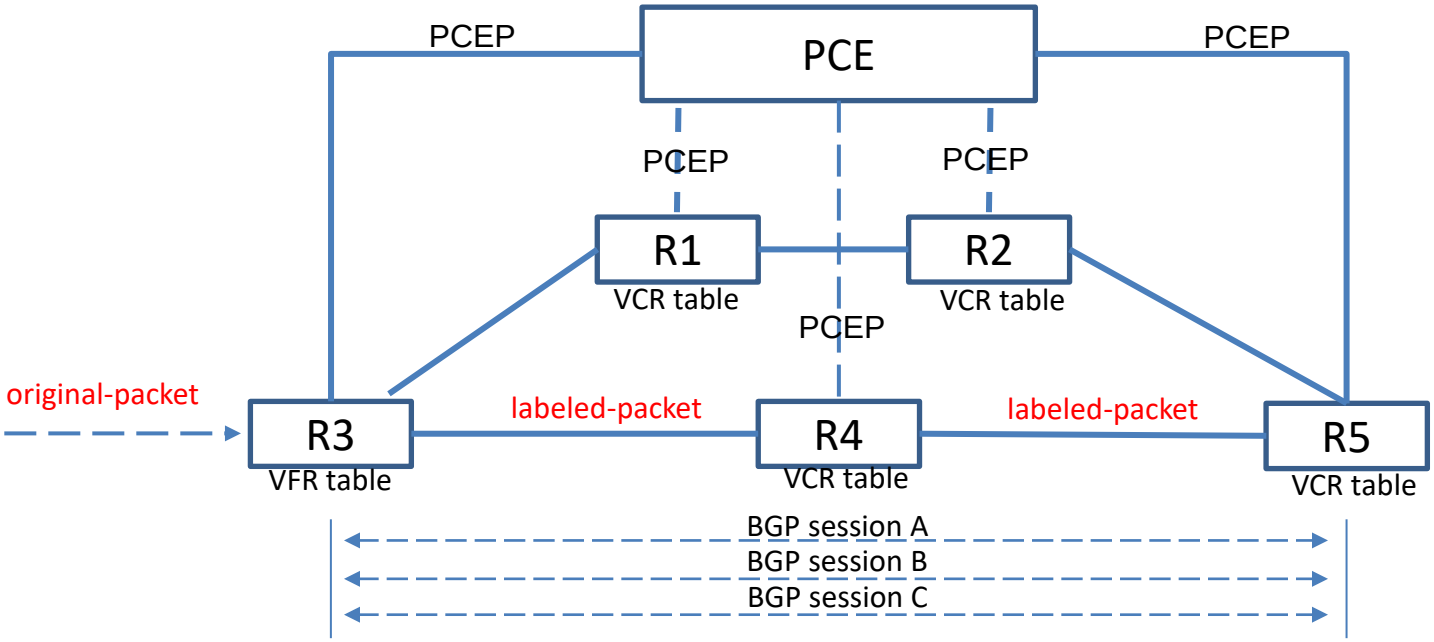
- RFC8821 describes an architecture for providing traffic engineering in a native IP network by using multiple BGP sessions and a PCE-based central control mechanism.

- RFC9050 specifies the procedures and PCEP extensions for PCECC to derive MPLS Label Switched Paths.

- With the large scale deployment of Ethernet interface, it is possible to use the info contained in the Layer2 frame to simplify the E2E packet forwarding procedure.

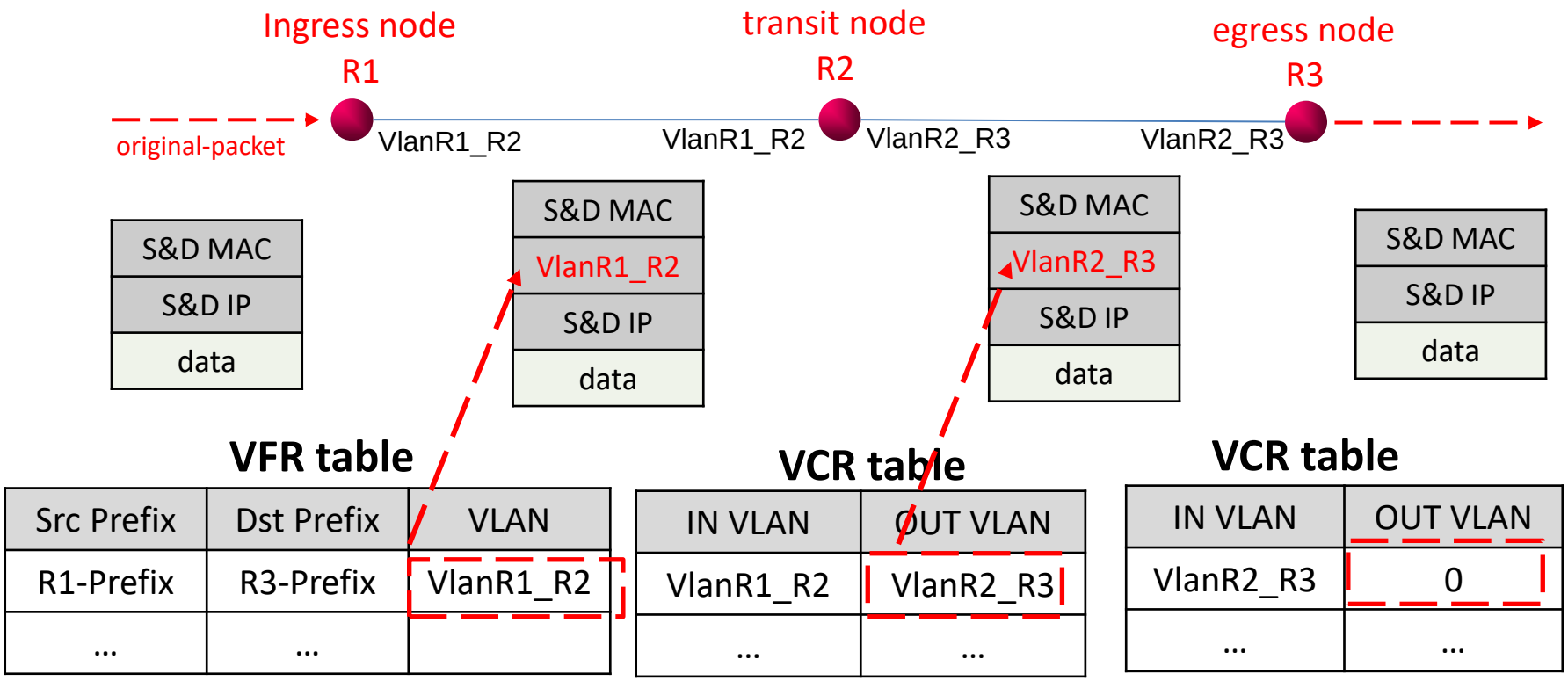
- Based on the mechanism mentioned in RFC9050 and RFC8821, this document defines PCEP extension for VLAN-based traffic forwarding in native IP network and describes the processes of the data packet forwarding system based on VLAN info.

Procedures for VLAN-based Traffic Forwarding



1. The PCE calculates the explict route and sends the route information to the PCCs through PCInitiate messages.
2. The ingress PCC forms a VLAN-Forwarding routing(VFR) table, the transit PCC and the egress PCC forms a VLAN-Crossing routing(VCR) table.
3. The packet to be guaranteed matches the table and then be labeled with corresponding VLAN tag.
4. The labeled packet will be further sent to the PCC's specific subinterface identified by the VLAN tag and then be forwarded.

Data Packet Encapsulation Process



- This mechanism uses a completely new address space and is suitable for ipv4 and ipv6 networks and can leverage the existing PCE technologies as much as possible.

Updated Contents

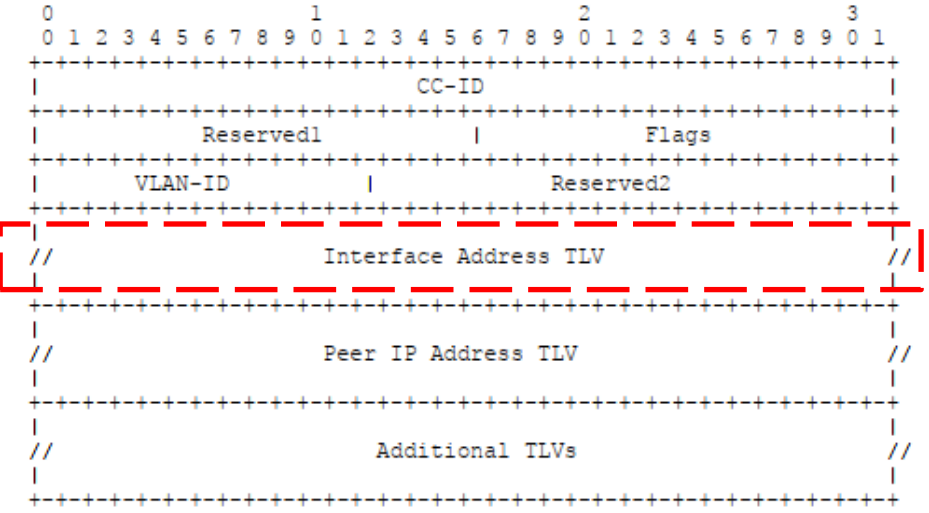


Figure 5: VLAN Forwarding CCI Object

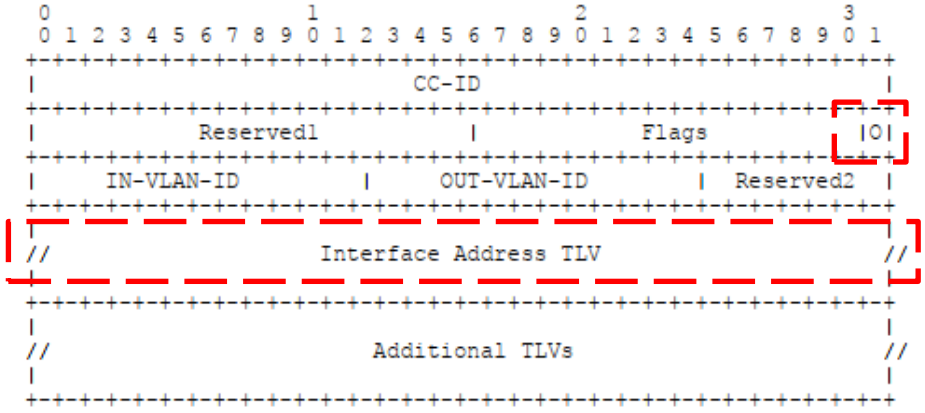


Figure 6: VLAN Crossing CCI Object

- Interface Address TLV is included to specify the interface which will set up the vlan defined in the VLAN Forwarding CCI Object.

- Flags - O bit (out-label) : If the bit is set to '1', it specifies the VLAN is the out-VLAN, and it is mandatory to encode the egress interface information. If the bit is not set or set to '0', it specifies the VLAN is the in-VLAN.

Updated Contents

Table 1: Message Information

No.	Peers	Type	Message Key Parameters
M1	PCE/R1	PCInitiate	CC-ID=X1
M1-R		PCRpt	VLAN Forwarding CCI Object (Peer_IP=R6_A, Interface_Address=INF1, VLAN_ID=VLAN_R1_R2)

Table 2: Message Information

No.	Peers	Type	Message Key Parameters
M1	PCE/R2	PCInitiate	CC-ID=X1
M1-R		PCRpt	VLAN crossing CCI Object(IN) (O=0, Interface_Address=INF1, IN_VLAN_ID=VLAN_R1_R2) VLAN crossing CCI Object(OUT) (O=1, Interface_Address=INF2, OUT_VLAN_ID=VLAN_R2_R3)
M2	PCE/R3	PCInitiate	CC-ID=X1
M2-R		PCRpt	VLAN crossing CCI Object(IN) (O=0, Interface_Address=INF1, IN_VLAN_ID=VLAN_R2_R3) VLAN crossing CCI Object(OUT) (O=1, Interface_Address=INF2, OUT_VLAN_ID=VLAN_R3_R4)
M3	PCE/R4	PCInitiate	CC-ID=X1
M3-R		PCRpt	VLAN crossing CCI Object(IN) (O=0, Interface_Address=INF1, IN_VLAN_ID=VLAN_R3_R4) VLAN crossing CCI Object(OUT) (O=1, Interface_Address=INF2, OUT_VLAN_ID=VLAN_R4_R6)
M4	PCE/R6	PCInitiate	CC-ID=X1
M4-R		PCRpt	VLAN crossing CCI Object(IN) (O=0, Interface_Address=INF1, IN_VLAN_ID=VLAN_R4_R6) VLAN crossing CCI Object(OUT) (O=1, Interface_Address=INF2, OUT_VLAN_ID=0)

Next Step

- More solutions & comments are welcome.

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